

GROUNDWATER MANAGEMENT OBJECTIVES For the Deer Creek Water Exchange Pilot Program In the Deer Creek Irrigation District

INTRODUCTION

Deer Creek Irrigation District is located in the lower Deer Creek watershed (see Figure 1). The Deer Creek Water Exchange Pilot Program will test the effectiveness of increasing fish transportation flows in Deer Creek, by allowing groundwater to be used in-lieu of bypassed surface water. Operation of the pilot program will follow the Scope of Work outlined in Exhibit A and the guidelines set forth in the Groundwater Management Objectives listed below. The Groundwater Management Objectives utilize groundwater level and groundwater quality data collected before, during and after pumping to establish a clear set of criteria for pilot program operations.

The overall management goals of the Deer Creek Irrigation District are to maintain the groundwater surface elevation at a level that will assure an adequate and affordable irrigation water supply, and to assure a sustainable supply of good quality groundwater for agricultural and domestic use. In order to maintain this goal, it is recognized that the operational criteria presented in the Groundwater Management Objectives may need to be adjusted as additional operational data for the program are established.

PROGRAM COORDINATION and CHAIN OF AUTHORITY

Groundwater wells installed as part of the Deer Creek Water Exchange Pilot Program will be owned and operated by Deer Creek Irrigation District (DCID). As such, DCID will serve as the Lead Agency for the program. Deer Creek Irrigation District will coordinate management of the Pilot Program with other local and county water management programs. Locally, the Deer Creek Watershed Conservancy has developed a strategic plan for watershed management. At the county level, Tehama County manages groundwater resources through their AB 3030 Groundwater Management Plan and through several groundwater protection ordinances.

The Tehama County AB 3030 Groundwater Management Plan is administered by the Tehama County Flood Control and Water Conservation District (TCFCWCD). The TCFCWCD has established a Technical Advisory Committee (AB 3030 TAC) that serves as an advisory body to the TCFCWCD Board. The TCFCWCD Board and the AB 3030 TAC hold monthly meetings to work on implementation of the AB 3030 plan and to develop policy on local groundwater management issues.

Tehama County also administers several groundwater-related ordinances. Chapter 9.4, "Aquifer Protection", of the Tehama County Code incorporates County Ordinance No. 1617. Tehama County Ordinance No. 1617 requires a permit to extract groundwater for the purpose of using or selling the water for use on lands other than the parcel from which the extraction occurs. Permitting authority of this ordinance is through the Tehama County Board of Supervisors (BOS), but administration of the permitting process is through the Tehama County Health

Agency, Environmental Health Division (EHD). The EHD also oversees permitting associated with drilling and installation of all new wells.

With respect to the Deer Creek Water Exchange Pilot Program, primary coordination of permitting and reporting will be through the Tehama County HED, via the Board of Supervisors. Secondary coordination at the county level will be through the AB 3030 TAC, via the TCFCWCD. At the local level, coordination will be through the Deer Creek Watershed Conservancy, DCID Board and the surrounding private stakeholders.

During operation of the Deer Creek Water Exchange Pilot Program, a Deer Creek Water Advisory Committee (WAC) will be established. The WAC will help oversee the development and compliance of the program, interface with the local, county and State representatives, and work towards a more compressive groundwater management plan for the Deer Creek watershed.

The Deer Creek WAC shall include approximately six (6) to nine (9) persons. At least one representative from each of the following entities will be invited to participate:

- Deer Creek Irrigation District,
- Stanford Vina Irrigation Company,
- Deer Creek Watershed Conservancy,
- Tehama County AB 3030 TAC,
- Tehama County Health Agency, EHD
- Northern District Department of Water Resources,
- California Department of Fish and Game,
- Private groundwater users outside the DCID and SVIC service area, but within the lower Deer area.

Issues regarding program operations and/or noncompliance will be initiated at the local level through the WAC. The Deer Creek WAC will coordinate with, and report to, the State and County through the respective State and County members that serve on the WAC. Official reporting and annual program review associating with the permitting process for the pilot program will coordinated directly with the Tehama County Health Agency EHD. It is the hope and intent that most program issues can be resolved at the WAC level. However, the Tehama County BOS, through the provisions in Ordinance No. 1617, will have the final decision making control over the permitting of program operations.

The chain of partnerships described above is a vitally important tool for providing input and dispensing information to local, county and state groups. The lower Deer Creek area has its own unique set of water management objectives, as do many other local areas within Sacramento Valley. Using the proper chain of partnerships, groundwater management objectives can be established to include local needs, while providing a regional framework of legal authority and protection of groundwater resources.

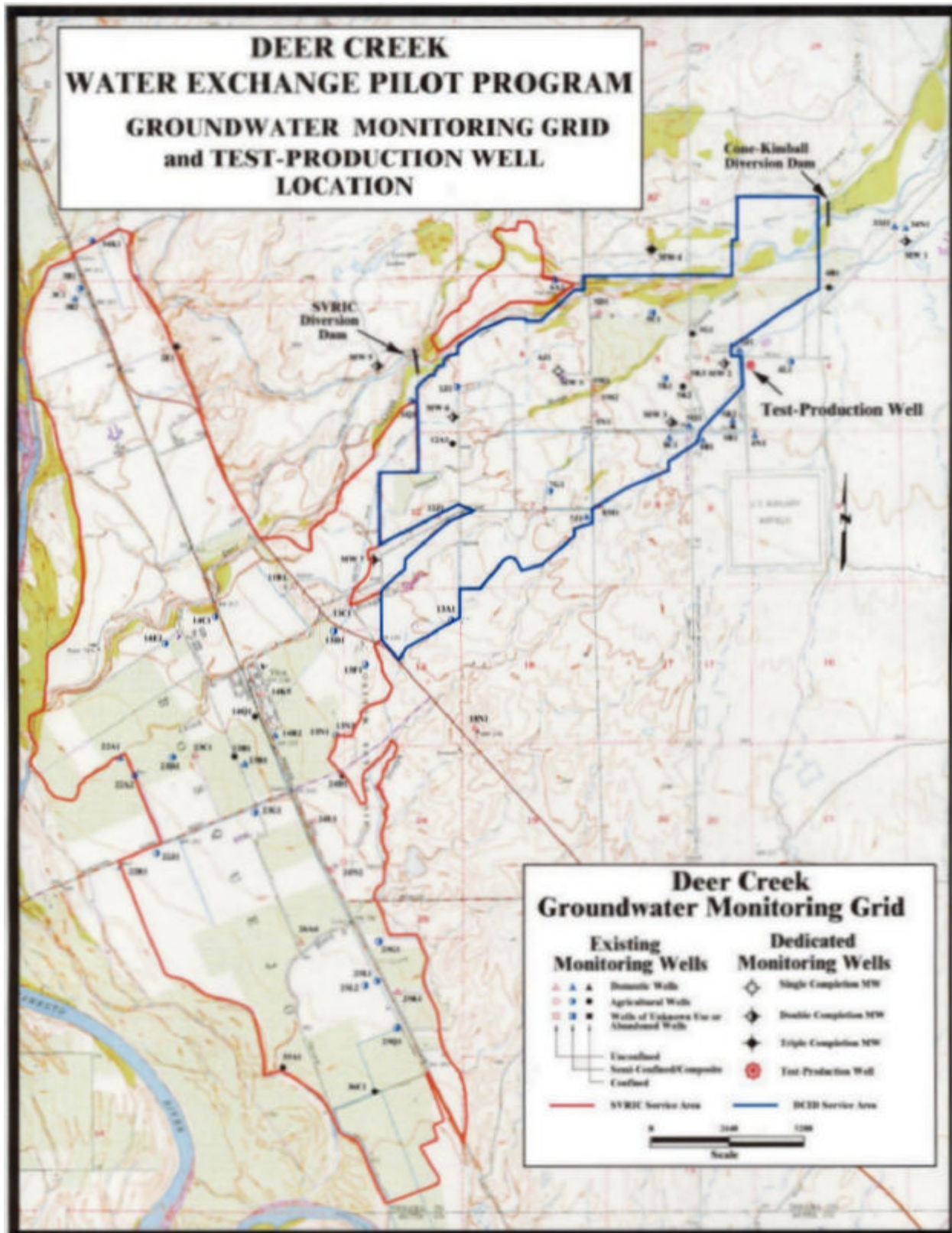


Figure 1. Deer Creek Irrigation District and Lower Deer Creek Groundwater Monitoring Grid.

GROUNDWATER LEVEL CRITERIA

One of the key criteria for program operations is maintaining a predetermined range of acceptable groundwater levels surrounding the pilot program pumping well. The acceptable range of groundwater level fluctuation during program operations was established based on historic groundwater level data and the estimated worse-case decline in groundwater levels associated with pilot well pumping. The predetermined range of acceptable groundwater level fluctuation has been reviewed and is supported by the DCID Board. Operation of the pilot program will proceed as long as there is compliance with the pre-agreed groundwater level criteria. The groundwater level monitoring location, timing, data reporting, acceptable range of fluctuation during program operations, and procedures for noncompliance determination, evaluation and program shutdown are presented below.

Groundwater Level Monitoring Network

Figure 1 shows the lower Deer Creek groundwater level monitoring network and identifies the location of the active monitoring wells (existing irrigation & domestic wells), as well as, the location of dedicated monitoring wells.

Monitoring Well Numbering System

All wells participating in the pilot program will be numbered according to the California State Well Numbering System as illustrated in Figure 2.

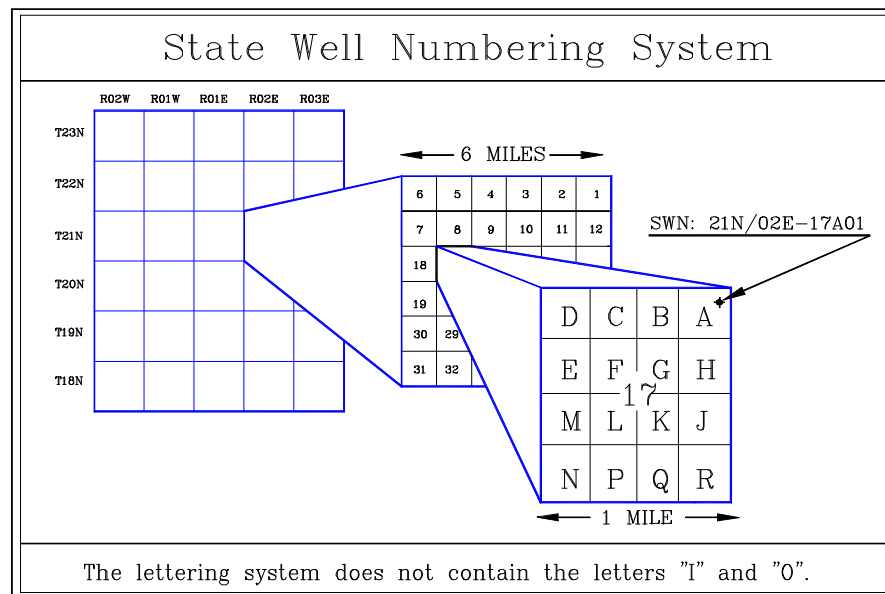


Figure 2. California State Well Numbering System.

Key Groundwater Level Monitoring Wells

Groundwater levels in key monitoring wells will be used to monitor compliance with the predetermined range of acceptable groundwater level fluctuation identified in the groundwater criteria below. Figure 3 shows the location of the seven key wells that will be used to evaluate compliance with the groundwater level criteria. The key wells were selected based on their construction, proximity to the pilot well, and their ability to represent groundwater levels in surrounding agricultural and domestic wells drawing from the upper Tuscan aquifer.

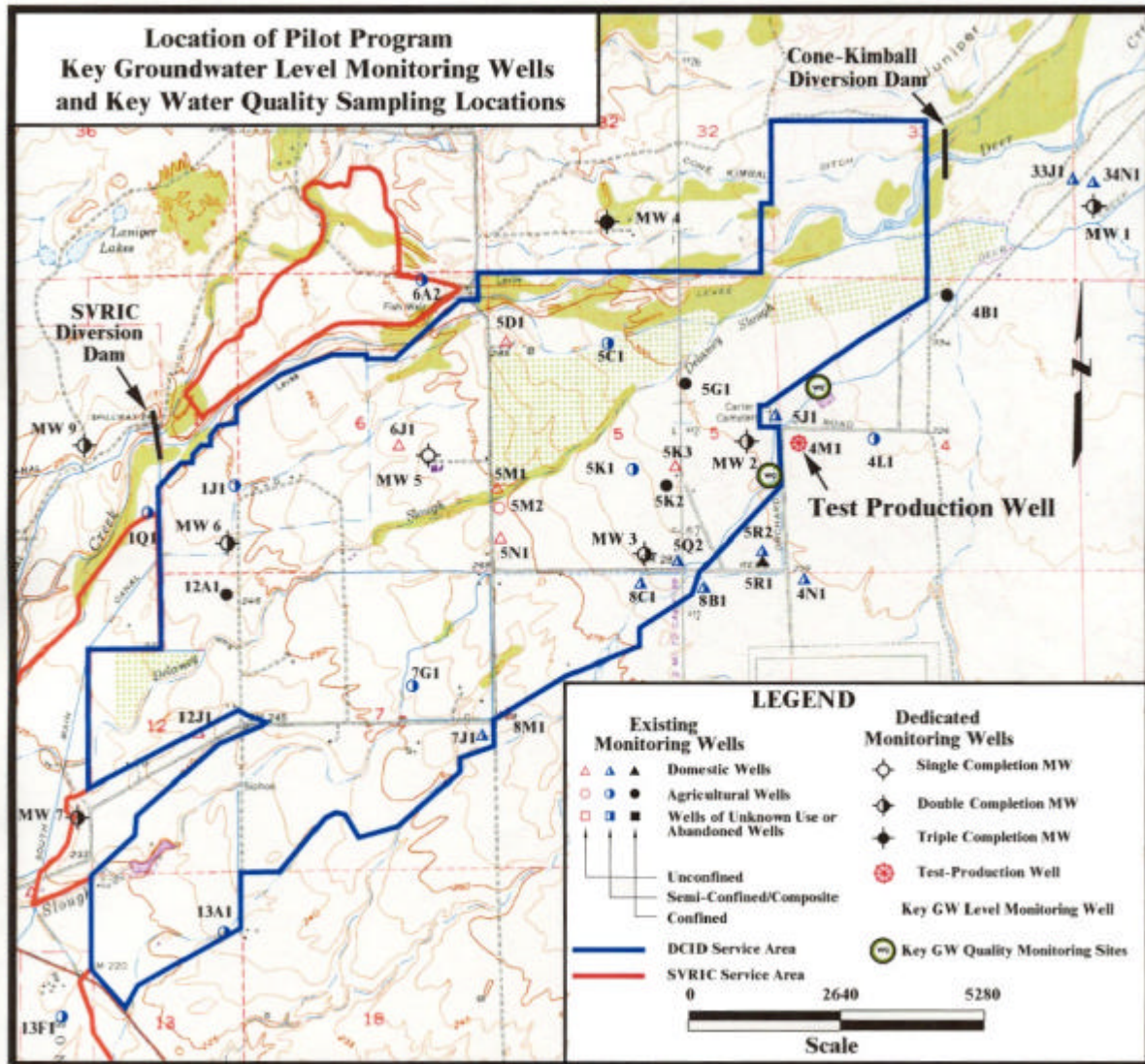


Figure 3. Key Groundwater Level Monitoring Wells and Key Water Quality Sampling Locations.

Key Monitoring Wells State Well Number	Well Use	Aquifer Production Zone	Total Depth (feet)	Perforation Interval (feet)
24N01W-05J01	Cemetery Well	Upper Tuscan	178	58-178
24N01W-05R02	Domestic	Upper Tuscan	160	118-160
24N01W-05J03 (MW 2s)	Monitoring Well	Upper Tuscan	385	271-385
24N01W-05Q03 (MW 3s)	Monitoring Well	Upper Tuscan	415	280-415
24N01W-05G01	Idle Irrigation	Upper Tuscan	490	130-490
24N01W-05K01	Idle Irrigation	Upper Tuscan	260	27-260
24N01W-04L01	Idle Irrigation	Upper Tuscan	526	117-520

Table 1. Key Well Construction and Use.

Groundwater Level Measurements

The Department of Water Resources will be responsible for monitoring groundwater levels during operation of the pilot program. Some of the monitoring wells in pilot program are also part of the summer Tehama County groundwater level monitoring grid. Tehama County will likely also measure groundwater levels in these wells during their regular summer monitoring schedule.

Frequency of Groundwater Level Measurements

Monitoring frequency will vary depending upon monitoring well location and type, and the program operations schedule.

During Periods of Non-Program Operation (pilot well not pumping): During non-program operations, the depth to groundwater will be measured in all wells within the Deer Creek monitoring grid at a minimum frequency of four times per year, according to the following schedule.

- Spring: (March or April)
- Summer: (July and August)
- Fall: (October)

In addition to the above monitoring, during periods of non-program operations, the seven key wells and the remaining dedicated monitoring wells within the Deer Creek monitoring grid will be equipped with automated groundwater level recording equipment. The automated equipment will be set to measure groundwater levels at a minimum frequency of six times per day. The data from this equipment will be downloaded a minimum of four times per year, according to the above schedule.

During Periods of Program Operation (pilot well pumping): During pilot program operations, the depth to groundwater will be measured in the Deer Creek monitoring wells that are east of Highway 99, at a minimum frequency of two times per month between April and October, and monthly from November through March.

In addition to the above monitoring, during periods of program operation, the seven key wells and the remaining dedicated monitoring wells within the Deer Creek monitoring grid will be equipped with automated groundwater level recording equipment. The automated equipment will be set to measure groundwater levels at a minimum frequency of twelve times per day. The data from this equipment will be downloaded two times per month between April and October, and monthly from November through March.

Acceptable Range of Groundwater Level Fluctuation During Program Operations

The acceptable range for groundwater level fluctuation during program operations were estimated for the seven key monitoring wells shown in Figure 2. These ranges are based on:

- review of the historic seasonal fluctuation of groundwater levels in domestic and agricultural wells surrounding the pilot program well,
- the estimated decline in surrounding groundwater levels in domestic and agricultural wells associated with pumping of the pilot well, and

- the ability of nearby third-party groundwater users to maintain an adequate and affordable supply of good quality groundwater for agricultural and domestic use.

In order to have adequate time to respond and make appropriate adjustments to program operations, the range limits are divided into a series of three warning stages. Each warning stage corresponds to a progressive increase in the decline in groundwater levels, and represents further movement towards noncompliance with the groundwater level criteria and eventual shutdown of program operations. Each warning stage also triggers a sequence of program management review and actions designed to alleviate any additional groundwater level decline.

Definition of Groundwater Level Warning Stages

The warning stages are developed and adopted by the DCID board. The stage criteria will also be reviewed by Tehama County AB 3030 TAC and EHD, and by local landowners during and a public meeting. The warning stages are subject to approval the Tehama County BOS through the permitting process for Tehama County Ordinance No. 1617. It is understood that adjustments to the warning stage criteria may be needed as data is collected during the pilot program. Procedures for adjustment to a warning stage will be similar to the initial development of the warning stage(s).

The historic groundwater level data along with the three warning stages for the seven key wells are presented in Figures 4 through 10. Stage 1, Stage 2 or Stage 3 warnings will be issued by the groundwater level monitoring staff when the measurements indicate that the following criteria have been met.

- Stage 1 Warning will be declared when the static groundwater level in any of the Key Wells falls below the Stage 1 warning line.
- Stage 2 Warning will be declared when the static groundwater level in any of the Key Wells falls below the Stage 2 Warning line.
- Stage 3 Warning will be declared when the static groundwater level in any of the Key Wells falls below the Stage 3 Warning line.

Upon recommendation of the DCID and approval of the Tehama County BOS, a Stage 1 and Stage 2 Warning may be rescinded when the groundwater levels rise above the corresponding Stage 1 Warning Line in the non-compliant Key Well(s).

Upon recommendation of the DCID and approval of the Tehama County BOS, the Stage 3 Warning may be rescinded when the groundwater levels rise above the Stage 2 Warning Line in the non-compliant Key Well(s). A Stage 3 Warning may also be temporarily downgraded to a Stage 2 Warning if, after review of all of the groundwater level data, the affected landowners, the DCID Board, and the Tehama County BOS unanimously agree to the temporary downgrade.

Evaluation for Compliance with Groundwater Level Criteria

Following each monitoring period, the Department of Water Resources will evaluate the groundwater level data for determination of compliance with the groundwater level criteria as stated in the Groundwater Management Objectives and shown in the Key Well Figures 4 through 10.

Compliance Reporting and Groundwater Level Data

During program operations, the Department of Water Resources will develop groundwater level compliance reports within 5 days of each monitoring period. Each report will provide a comparison of recently measured groundwater levels against the corresponding Key Well hydrograph and warning stage trigger levels. The groundwater level data and compliance reports will be made available to the general public over the Internet, through a link with the Northern District Department of Water Resources web site.

If wells are found to be in noncompliance with the groundwater level criteria, a noncompliance report will be submitted by the Department of Water Resources to the DCID Board and the Tehama County EHD within five (5) days of the last monitoring period. The noncompliance report will include information as to the regional extent and magnitude of the noncompliance and the character of the compliance violation (Stage 1, 2 or 3 Warning Level).

Response Action for Noncompliance with Groundwater Level Criteria

A series of response actions for each warning level are listed below. The intent of the following list is to provide a minimum level of required response actions, thereby maintaining flexibility for further action, as needed and appropriate, to maintain the general program goals of sustaining the groundwater resource while minimizing third-party impacts. Therefore, the magnitude and extent of possible response actions shall not be limited to those identified below:

Stage 1 Warning - Stage 1 response actions shall include remeasuring groundwater levels and reassessing the appropriateness of the GMO groundwater level criteria with respect to the given circumstances. The Department of Water Resources shall collect and present all pertinent hydrological data to the DCID Board, the EHD and the WAC for review. The WAC shall investigate possible causes for the noncompliance, and develop recommend actions to resolve the Stage 1 noncompliance. These recommendations shall be made in a timely manner not to exceed five (5) days after the reporting of the Stage 1 noncompliance. It shall be the intent of the review group to first make recommendations that focus on resolving the noncompliance through management actions and negotiations with all parties in the affected area. Additional action to help identify the cause for the noncompliance may include, but not be limited to, increasing the frequency of groundwater monitoring and re-assessing the existing appropriateness of the GMO groundwater level criteria.

Stage 2 Warning - Stage 2 response actions shall include more extensive monitoring and evaluation of the GMO groundwater level criteria with respect to the given circumstances. The Department of Water Resources shall collect and present all pertinent hydrological data to the DCID Board, the EHD and the WAC for review. The WAC shall investigate possible causes for the noncompliance, and develop recommend actions to resolve the Stage 2 noncompliance. These recommendations shall be made in a timely manner not to exceed five (5) days after the reporting of the Stage 2 noncompliance. Depending upon the circumstances surrounding the Stage 2 noncompliance, actions at this time could include shutting down the pilot program well if a Stage 3 noncompliance appears imminent. If the progression of groundwater levels towards a Stage 3 noncompliance appears slow or unlikely, other operational management methods may be implemented to avoid further decline of groundwater levels. The methods may include, but not be limited to, partial shutdown of the pilot well during periods of peak interference with surrounding pumping wells, reduction in the volume of daily groundwater extraction from the

pilot well or voluntary water conservation measures. Implementation of Stage 2 management actions may require action by the Tehama County BOS.

Stage 3 Warning - Stage 3 management actions shall consist of terminating the groundwater pumping associated with the pilot program and collecting groundwater level recovery data in the surrounding wells. Groundwater level recovery data will be collected by the Department of Water Resources and presented to the DCID Board, the EHD and the WAC for review. The WAC shall investigate the recovery from Stage 3 noncompliance levels, and develop recommend actions as to further program operation.

Supporting Data

When possible, groundwater level and groundwater quality data from surrounding Tehama County areas will be used to support evaluation of existing conditions in the DCID area.

GROUNDWATER QUALITY CRITERIA

Maintaining a minimum level of acceptable water quality from the pilot program pumping well is the second criteria for program operation. The water quality criteria will require that groundwater from the pilot well will be maintained above the Maximum Contaminant Level (MCL) established for agricultural use in the United States by the Food and Agriculture Organization of the United Nations. For some minerals and nutrients, no agricultural MCL's have been established. In these situations, water quality from the pilot well will be maintained at level that is equal to, or better than, the existing quality of surface water that is currently being diverted. The water quality standards for agriculture are listed in Table 1.

The range of acceptable groundwater quality has been reviewed and is supported by the DCID Board. Operation of the pilot program will proceed as long as there is compliance with the pre-agreed to groundwater quality criteria. The location and frequency of groundwater quality monitoring, the reporting of the data, and management action for noncompliance are presented below.

Water Quality Monitoring Network

Figure 2 shows the water quality monitoring network and identifies the location of the surface and groundwater monitoring sites. All wells participating in the pilot program are numbered according to the California State Well Numbering System illustrated in Figure 2.

Key Water Quality Monitoring Sites

Three key water quality monitoring sites will be used to monitor compliance with the water quality criteria.

- Site 1: Sample and test surface water quality in the distribution system, above the point where groundwater from the pilot well discharges into the system.
- Site 2: Sample and test the groundwater quality as it discharges from the pilot well.
- Site 3: Sample and test the surface water quality in the distribution system below the point where groundwater from the pilot well discharges into the system.

Water Quality Sampling and Testing

The Department of Water Resources will be responsible for field collection and testing of surface and groundwater quality samples. Analytical testing will be conducted at a State of California approved laboratory and will include analysis for minerals, trace metals and nutrients. Minerals analysis will include testing for conductivity, pH, temperature, alkalinity, total dissolved solids, total hardness, boron, calcium, chloride, magnesium, potassium, sodium and sulfate. Trace metal analysis will include testing for aluminum, arsenic, barium, cadmium, chromium, copper, iron, lead, manganese, mercury, nickel, selenium and zinc. Nutrient analysis will include testing for ammonia, dissolved orthophosphate, nitrite, nitrate, and total phosphorus.

Parameter	Aluminum	Arsenic	Boron	ASAR ²	Cadmium	Chloride	SC ³	TDS ⁴
Ag. MCL ¹ (mg/l)	5.0	0.1	0.7	< 3	0.01	106	0.7	450
Parameter	Manganese	Copper	Nickel	Iron	Selenium	Lead	Zinc	
Ag. MCL ¹ (mg/l)	0.2	0.2	0.2	0.3	0.02	5.0	2.0	
1. MCL = Agricultural Maximum Contaminant Level 2. ASAR = Adjusted Sodium Absorption Ratio 3. SC = Specific Capacity measured in micro-mhos/cm 4. TDS = Total Dissolved Solids								

Table 1. Agricultural Water Quality Standards Established by Food and Agriculture Organization of the United Nations.

Frequency of Water Quality Monitoring

The frequency of water quality monitoring at the three key sites will depend somewhat on the analytical results of the pre-project sampling. However, based on historic surface water and groundwater quality data for the area, it is estimated that water quality samples will be collected according to the following schedule.

- At least once prior to the start of the start of the pilot program pumping,
- Once within 5 days after the start of the pilot program,
- Once every 30-days for subsequent program pumping, and
- Once at the seasonal conclusion of the program.

Water Quality Warning Stages

Unlike groundwater levels that can fluctuate significantly depending upon the surrounding aquifer demand, groundwater quality is slightly more of a fixed quantity. Although there may be some fluctuation in groundwater quality as isolated aquifer zones become flushed and recharged, by in large, the fluctuations won't likely be significant. Because of these factors, there is little benefit in developing a series of warning stages for decreasing water quality. Instead, following each monitoring period, the Department of Water Resources will evaluate the surface and groundwater water quality data for compliance with the MCL's for agricultural use as listed in Table 1.

Compliance Reporting of Water Quality Data

During program operations, the Department of Water Resources will submit the analytical results from the water quality testing within 5 days of receiving the data from the lab, and within 14 days of the sampling date. Each report will provide a comparison of recently measured water quality data against the agricultural MCL's. The water quality data will be made available to the general public over the Internet, through a link with the Northern District Department of Water Resources web site.

Response Action for Noncompliance with Water Quality Criteria

If wells are found to be in noncompliance with the water quality goals in Table 1, the Department of Water Resources will develop and submit to the DCID Board, the EHD and the WAC recommend actions to improve water quality. The recommended corrective actions will vary depending upon which water quality parameters are exceeding the agricultural MCL. Corrective actions may include, but not be limited to, mixing of poor quality water with water of a higher quality, treatment of the poor quality water or termination of pumping from the pilot well.

ANNUAL REPORTING

An annual report will be prepared in the fall at the conclusion of the groundwater pumping. The annual report will summarize the status of groundwater levels and water quality for the DCID project area over the past year, compliance or non-compliance with groundwater management objectives of the pilot water exchange program, evaluation of the program and recommendations for improvement. Annual evaluation of the Deer Creek Groundwater Exchange Pilot Program should identify the effectiveness of the program for increasing fish transportation flows, providing clear groundwater management criteria for program operations, and maintaining local and county goals for groundwater management.

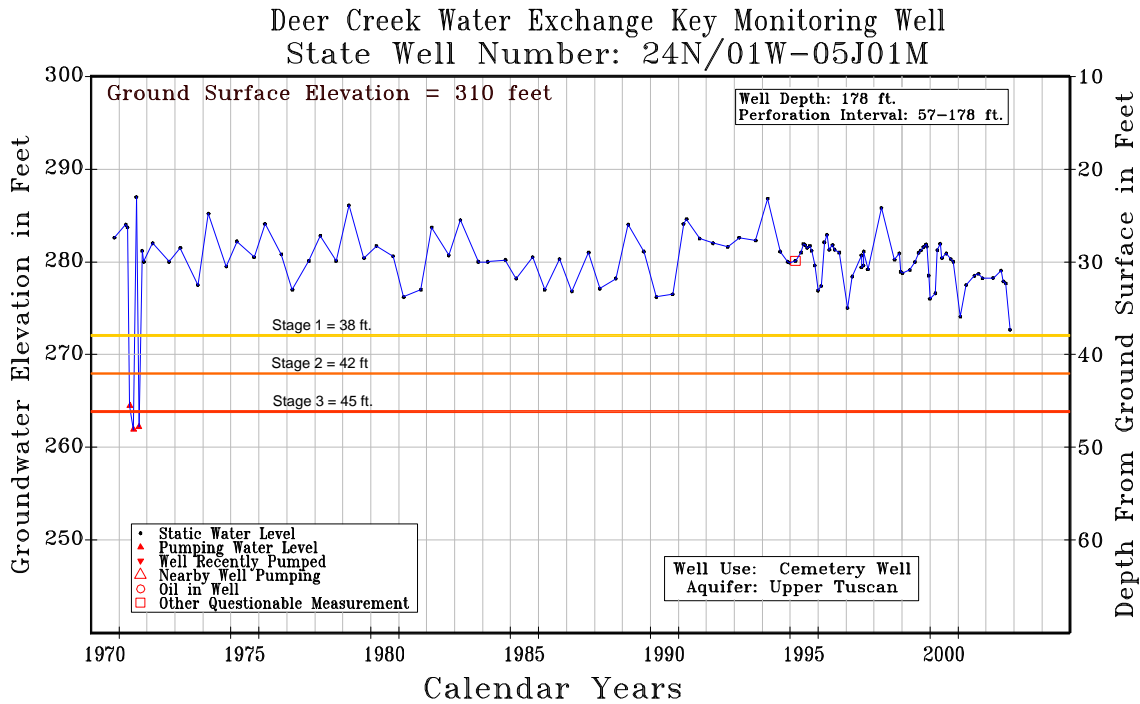


Figure 4. Groundwater Level Stages for Key Well: 24N/01W-05J01

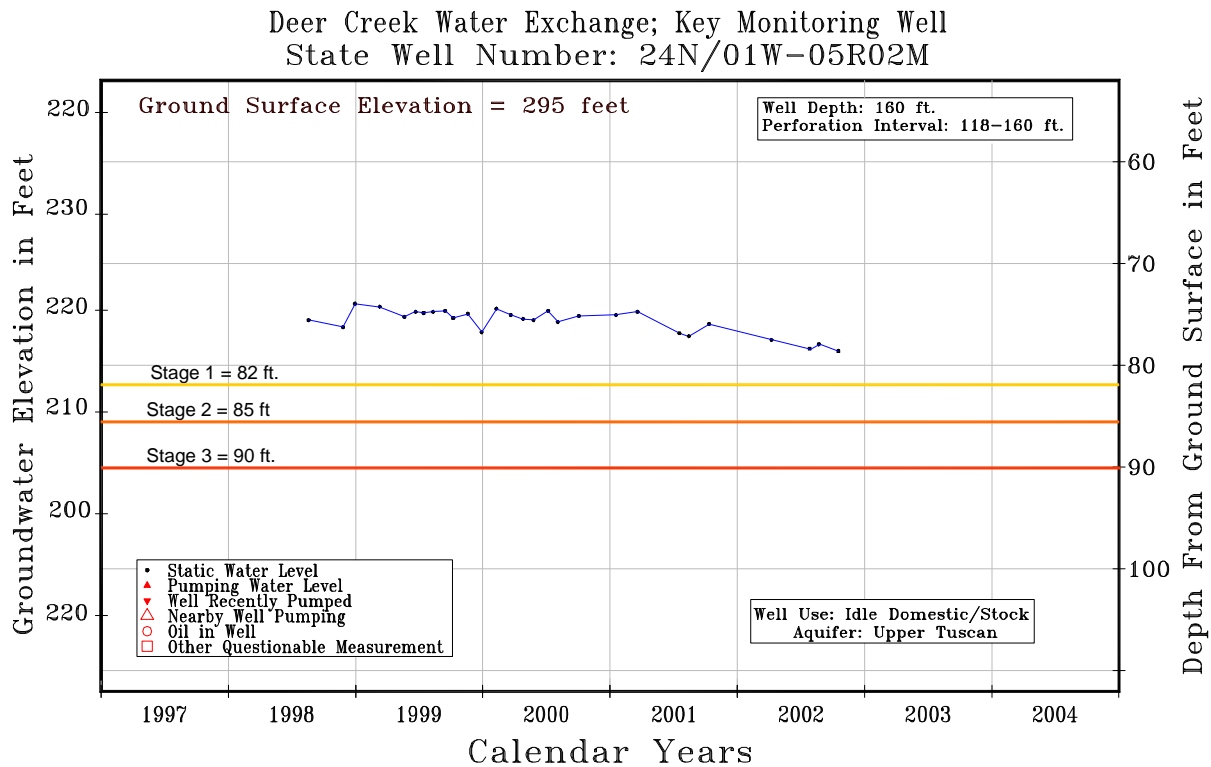


Figure 5. Groundwater Level Stages for Key Well: 24N/01W-05R02

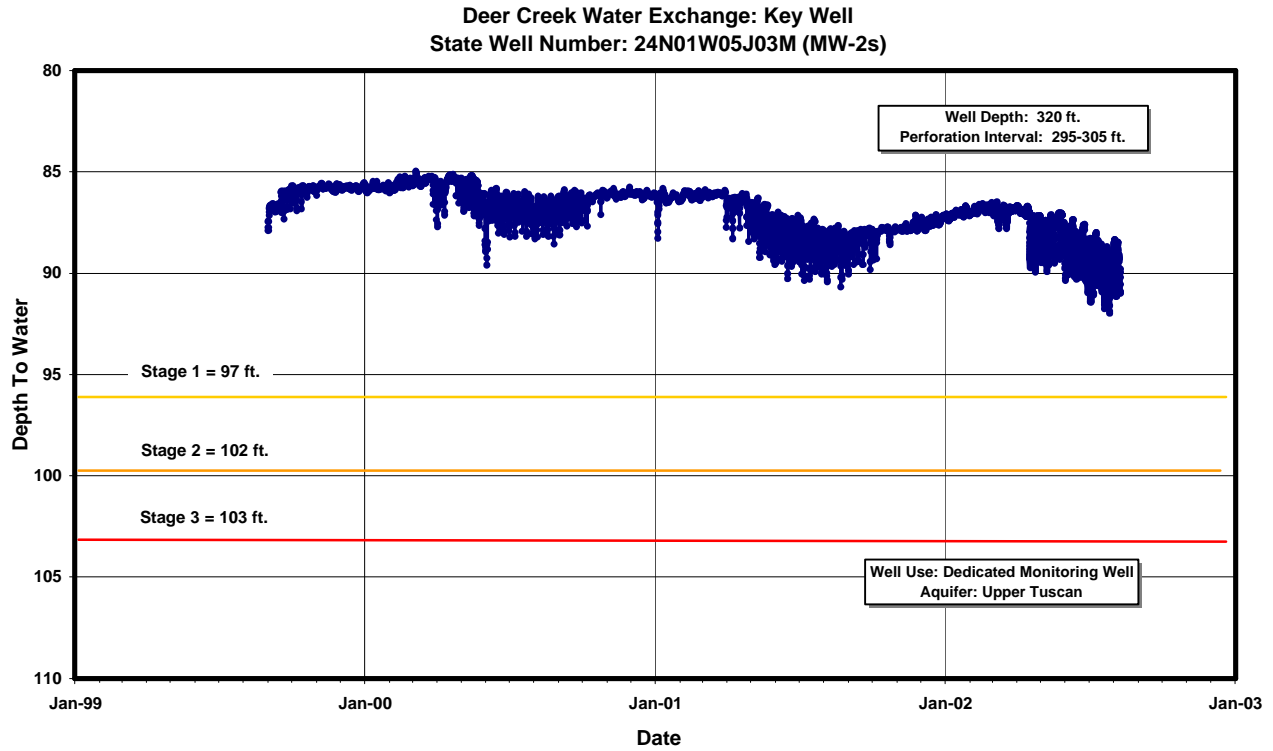


Figure 6. Groundwater Level Stages for Key Well: 24N/01W-05J03 (MW 2s)

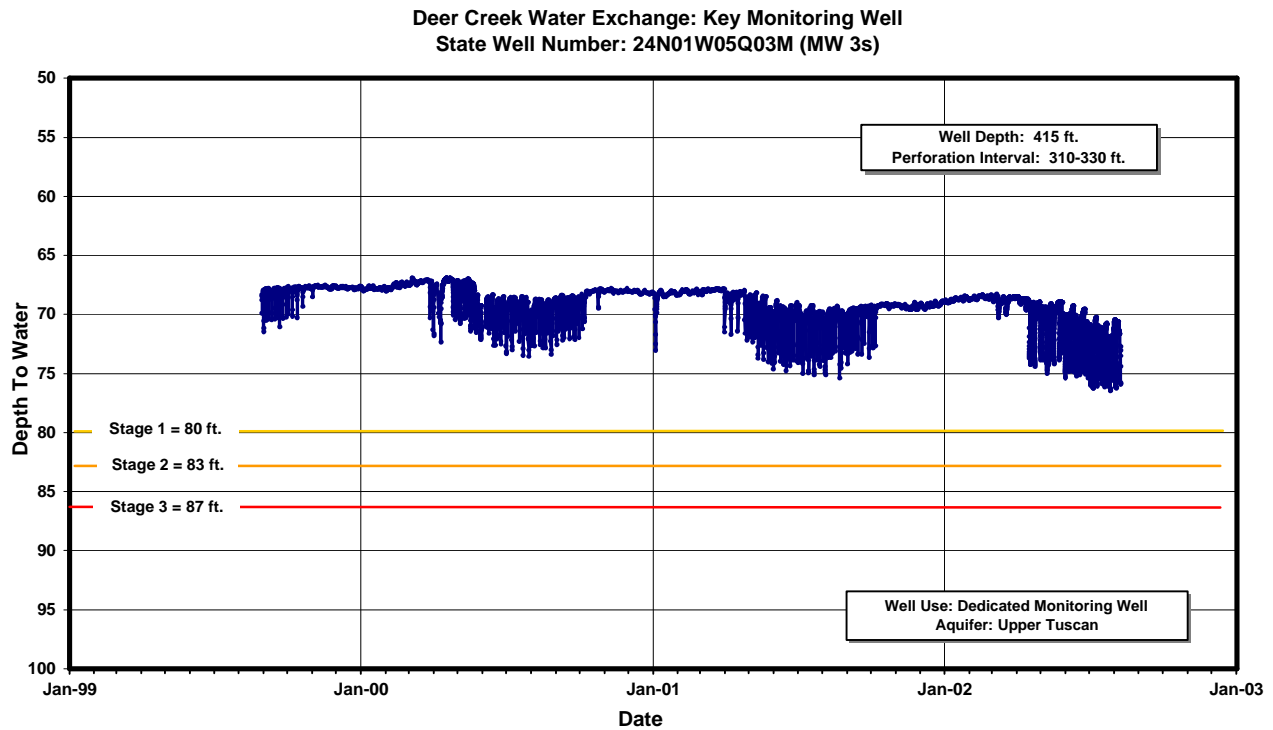


Figure 7. Groundwater Level Stages for Key Well: 24N/01W-0Q03 (MW 3s)

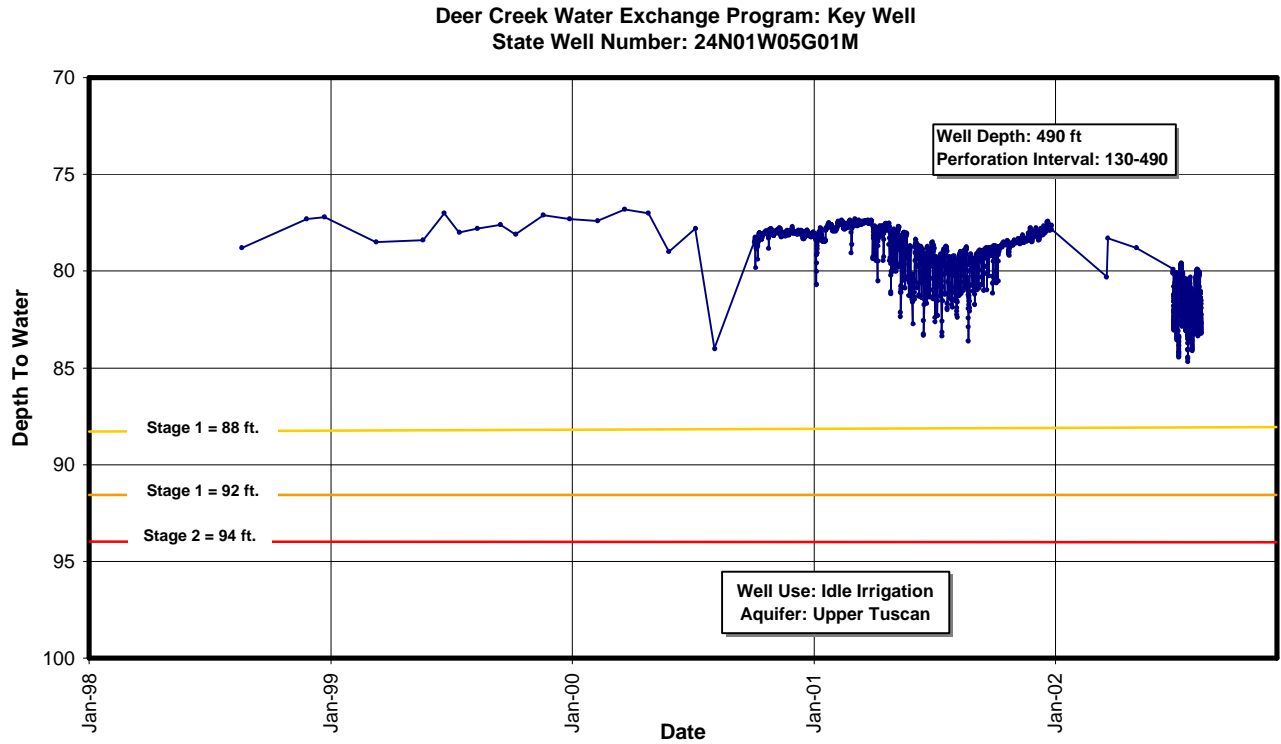


Figure 8. Groundwater Level Stages for Key Well: 24N/01W-05G01

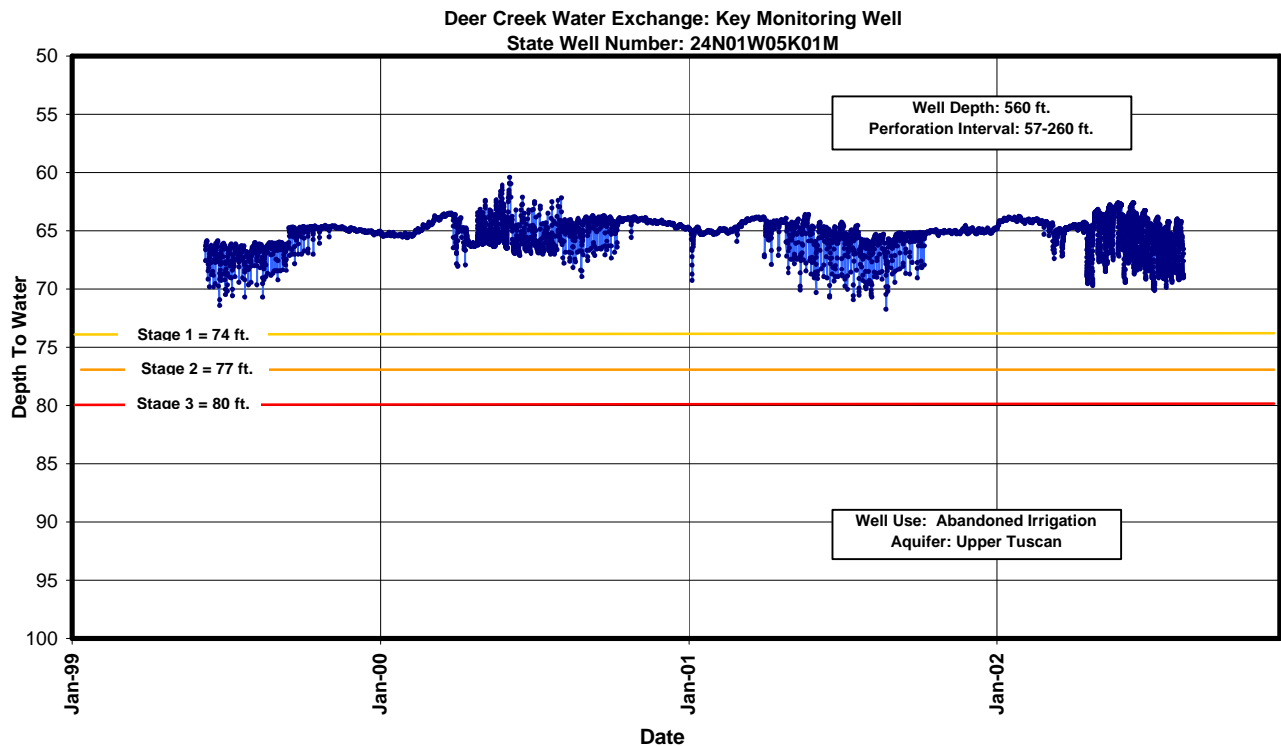


Figure 9. Groundwater Level Stages for Key Well: 24N/01W-05K01

Deer Creek Water Exchange: Key Monitoring Well
State Well Number: 24N01W04L01M

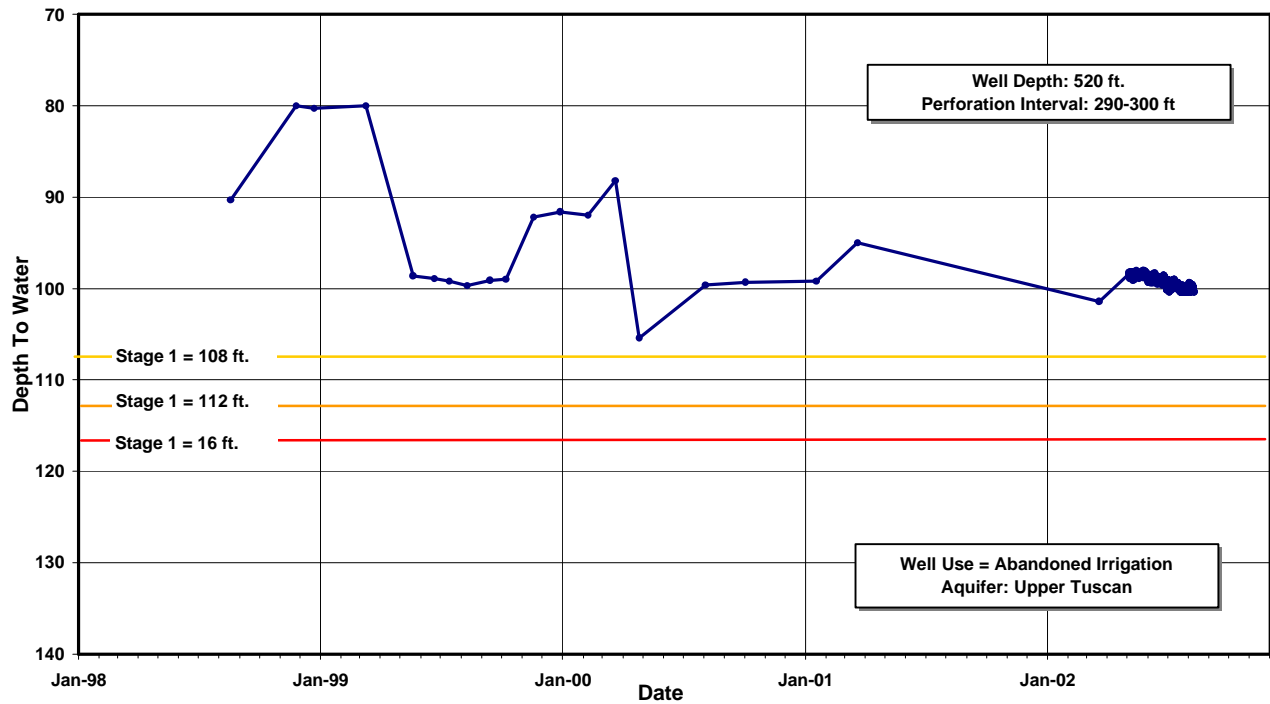


Figure 10. Groundwater Level Stages for Key Well: 24N/01W-04L01